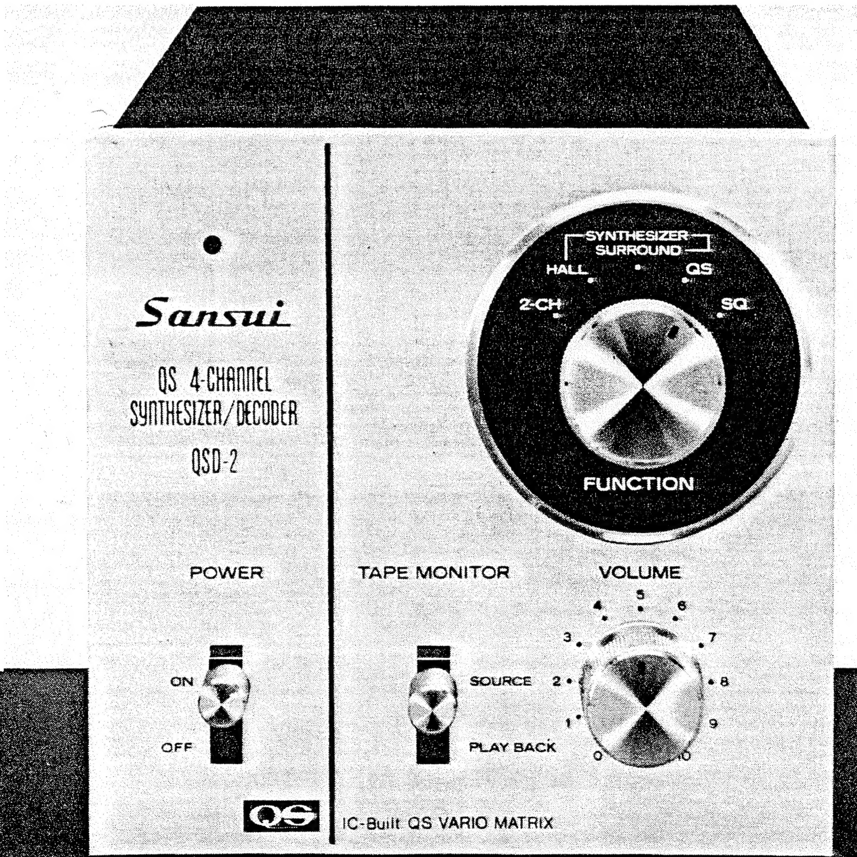
QS
4-CHANNEL STEREO

# SERVICE MANUAL

## 4-CHANNEL SYNTHESIZER DECODER
## SANSUI QSD-2




Sansui

SANSUI ELECTRIC CO., LTD.

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This service manual is designed for service engineers to repair, adjust, maintain and order the replacement parts of the QSD-2 correctly.
When ordering the parts, use the stock number and parts name specifically referring to the Parts Location and Parts Lists.
For general usage and maintenance of the unit, please refer to the Operating Instructions attached with the unit.

# 1. SPECIFICATIONS

**4-CHANNEL DECODER SECTION**
(TYPE-A QS VARIO-MATRIX)
FREQUENCY RESPONSE ..20 to 30,000Hz
DISTORTION ............less than 0.1% (at 1,000Hz)
SEPARATION
QS DECODER..........20dB (adjacent channels)
30dB (diagonal channels)
QS Synthesizer ........equivalent to QS Decoder
INPUT SENSITIVITY
2-CHANNEL INPUT ....130mV
TAPE MONITOR(2-CH)..130mV
MAX. INPUT CAPABILITY..3V
OUTPUT LEVEL (at 1,000Hz)
4-CHANNEL OUTPUT
RATED ..............730mV
MAX..................5V (0.5% THD)
TAPE REC............130mV

GENERAL
SEMICONDUCTORS......25 Transistors, 8 Diodes, 1 Zener Diode, 4 ICs, 1 LED
POWER REQUIREMENT
VOLTAGE ............120V, 50/60Hz
CONSUMPTION ......4.5 watts
DIMENSIONS ............126 mm (5") W
120 mm (4¾") H
288 mm (11⅜") D
WEIGHT ................2.5 kg (5.5 lbs.) net
3.3 kg (7.3 lbs.) packed

* Design and specifications subject to change without notice for improvements.

# TABLE OF CONTENTS

## 1) Matrix Section

Main Functions (HA-1328) —— Matrix Section

Other Functions
- Buffer Amp. (Input)
- Synthesizer
- SQ Section**
- Frequency Compensation
- Phase Shifter
- Buffer Amp. (Output)

## 2) Phase Discriminator Section

Main Functions
- Front, Back Control
  - Phase Discrimination Circuit (HA-1327)
  - Variable Resistor (Control) (HD-3130P)
- Left, Right Control
  - Phase Discrimination Circuit (HA-1317)
  - Variable Resistor (Control) (HD-3130P)

Accessory Functions
- SQ Playback Function
- FET Bias Section

# 2-3. Functions of QS Vario-Matrix Components

## 1) Matrix Section

**◇ Matrix**

Computes the input signals in the form of (L+R) and (L−R), then delivers four output signals (LF', LB', RF' and RB') according to the matrix coefficients provided by the control section, while creating maximum separation among the four signals.

**◇ Synthesizer**

Blends L/R audio signals in phase (for QS Synthesizer/Hall function) or in reverse phase (for QS Synthesizer/Surround function) to produce LT/RT composite signals.

**◇ Phase Matrix (SQ Section)**

A function for decoding SQ encoded signals. It is composed of phase shifters ($\varphi_1$, $\varphi_1$+j) for creating advancing 90-degree phase difference of a LT+RT, over an extended widerange of frequencies, and a gain control section that provides a LT+RT sum signal for separation control of the back channels.

**◇ Frequency Compensation**

Compensates frequency response to stabilize the localization of reproduced sound images in the low and high frequency ranges:

Low frequency compensation—Designed to improve Front-Back separation in particular

High-frequency compensation—Designed to improve L/R separation in particular

**◇ Phase Shifters ($\varphi_2$, $\varphi_2$+j)**

There is one ($\varphi_2$) for the front channels, and another ($\varphi_2$+j) for the back channels. Together they help to reproduce the QS-encoded signals (LF, LB, RF and RB) in phase one another as they were in the original sound field.

## 2) Phase Discriminator Section

Detects the location of an input signal by phase-discriminating the phase and level differences between LT/RT QS-encoded signal, converts this information into DC levels, and sends it to the control section.

**◇ Front/Back Control**

Controls the Front Left/Back left separation, and Front Right/Back right separation according to the phase difference between LT/RT QS-encoded signals.

**◇ Left/Right Control**

Controls front left/right separation and back left/right separation according to the phase difference between LT+RT∠−45° and LT−RT∠45°.

**1. Phase Discrimination Circuit**

Detects the phase difference between two input signals and delivers a DC output.

**2. Variable Resistance Circuit (Control Section)**

Changes the bias of the FET array IC (HD-3130P) according to the DC signal from the phase discriminator section. The conductance of the FETs then change continually to alter the matrix coefficients of the matrix section.

**Fig. 7**

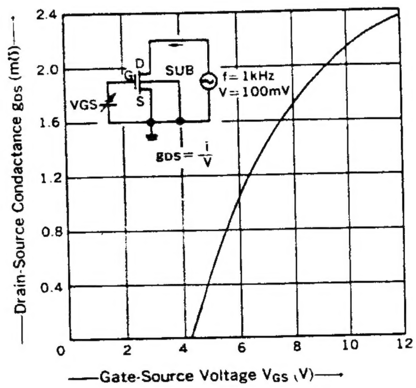



Fig. 7 shows the characteristic of the FETs inside the IC HD-3130P in terms of the gate-source voltage vs. drain-source conductance.

*QS is a trademark of Sansui Electric Co., Ltd.
**SQ is a trademark of CBS Inc.

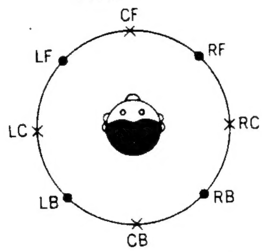
# 2. OPERATIONS (Refer to Block Diagram on Page 9)

## 2-1. Basic Operations of QS Encoder & QS Decoder

### 1) QS Encoder

While a conventinnal stereo recording transmits L/R positional information in the form of relative level differences between L/R signals, the QS Encoder additionally transmits front/back positional information in the form of phase differences between L/R signals.

Fig. 1 Original Sound Field




In other words, the QS Encoder is able to transmit signals in full 360-degree directions in an original sound field, by combining LT/RT amplitude differences (for storing left/right information) and LT/RT phase differences (for storing front/back information), and thus offers the advantage of being able to use all existing stereo transmission channels. Consequently, it is highly compatible with mono and stereo playback, yet provides outstanding high-fidelity 4-channel reproduction results. The conceptual diagram of the QS Encoder, and the mathematic equations behind it, are presented below:

Fig. 2 Conceptual Diagram of QS Encoder

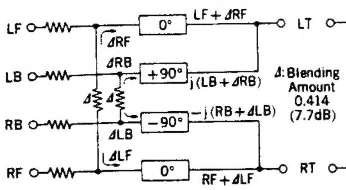
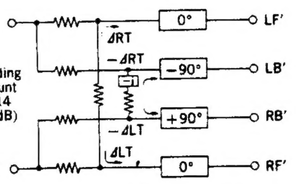



Fig. 3 Conceptual Diagram of QS Decoder




The encoder outputs (decoder inputs), LT and RT, are given by

$LT = LF + \Delta RF + j(LB + \Delta RB)$ $\quad RT = RF + \Delta LF - j(RB + \Delta LB)$

The decoder outputs, LF', LB', RB' and RF', are given by

$LF' = LT + \Delta RT$ $\quad RB' = j(RT - \Delta LT)$

$LB' = -j(LT - \Delta RT)$ $\quad RF' = RT + \Delta LT$

The QS Encoder provided for aligning the QS Decoder provides the following outputs:

LF LT : RT = 1 : 0.414 (7.7dB) $\quad$ RF LT : RT = 0.414 (7.7dB) : 1

CF LT : RT = 1 : 1 $\quad$ CB LT : RT = 1 : 1

The LF, RF, CF and CB represent sound sources in the original sound field.

### 2) QS Decoder (Basic Matrix System)

By performing mathematical operations contrary to those accomplished by the QS Encoder, the QS Decoder provides output signals that have the same characteristics (level, phase, directionality) as the signals in the original sound field.

For example, an LF signal in the original sound field, which was encoded by the QS Encoder as LT=1, RT=0.414, is now reproduced by the QS Decoder in the form of the following four output signals:

$LF' = LT + \Delta RT = 1 + (0.414)^2 = 1.171 \longrightarrow 1.00\,(0dB)$

$LB' = -j(LT - \Delta RT) = -j(1 - 0.414 \times 0.414) = -j\,0.828 \longrightarrow -j\,0.707\,(-3dB)$

$RF' = RT + \Delta LT = 0.414 + (0.414 \times 1) = 0.828 \longrightarrow 0.707\,(-3dB)$

$RB' = j(RT - \Delta LF) = j(0.414 - 0.414 \times 1) = 0 \longrightarrow 0\,(-\infty dB)$

In other words, as Fig. 4 shows, the adjacent channels will have crosstalk of −3dB each, but the diagonally opposite channel will have no crosstalk (−∞dB).

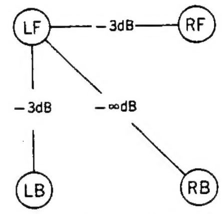



Fig. 4 Separation of QS Decoder

## 2-2. Basic Operations of QS Vario-Matrix Decoder (QSD-2)

The QS Decoder shown in Fig. 3 provides output signals that closely correspond, in terms of level, phase and directionality, with the signals in the original sound field, but it is the QS Vario-Matrix Decoder that eliminates the crosstalk to the adjacent channels and defines the location of each reproduced signal more clearly.

The QSD-2 QS Vario-Matrix Decoder performs various functions as outlined in the following paragraphs, and faithfully reproduces each and every one of the signals in the original sound field with greatly improved inter-channel separation as Fig. 6 shows.

The improvement in the inter-channel separation is a technical feature of the QS Vario-Matrix Decoder, and is accomplished by scanning and sensing the front/back and R/L direction of the predominant sound source, and varying the matrix coefficients accordingly from moment to moment (hence the name QS vario-matrix). At the same time, it has the advantage that lower-level sounds in all other directions are reproduced in full.

Fig. 5 Block Diagram of QSD-2

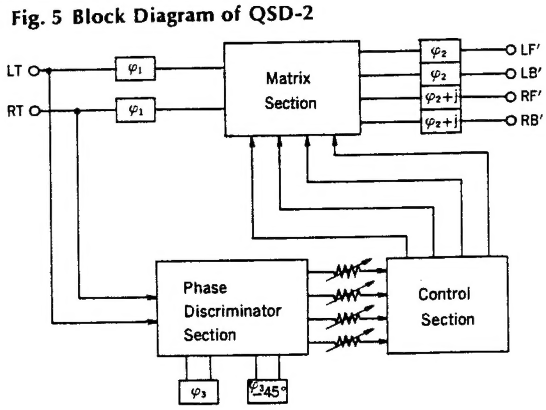
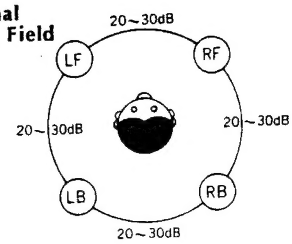


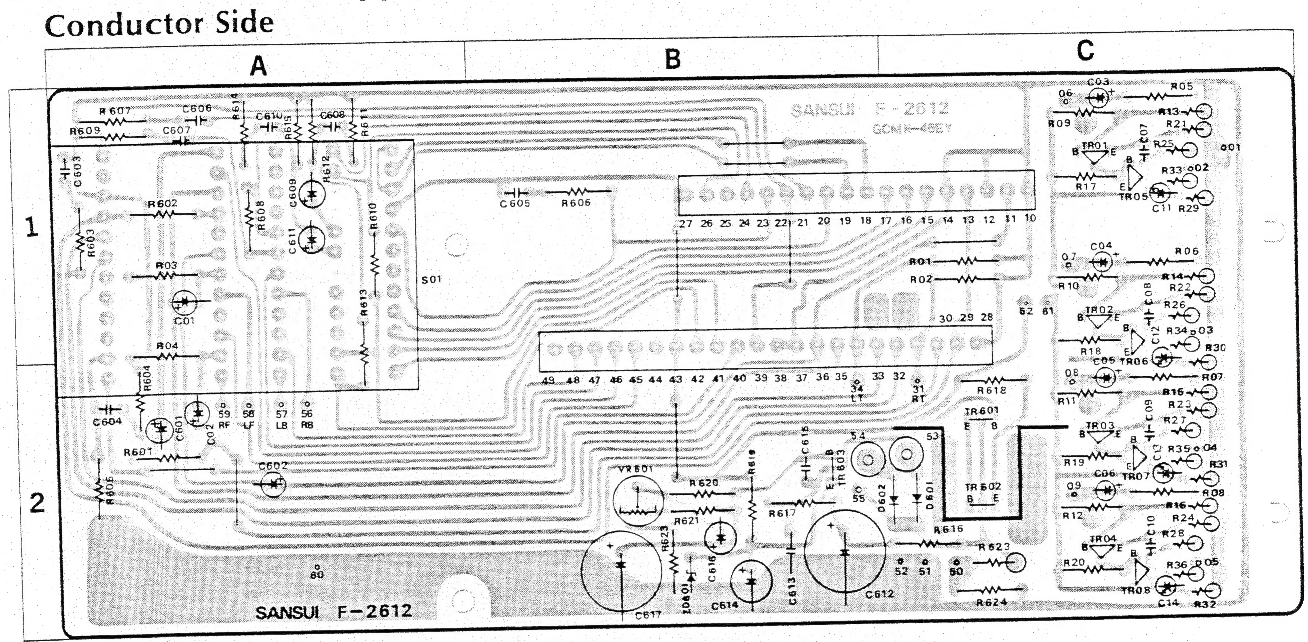

Fig. 6 Original Sound Field



# 3. PARTS LOCATION AND PARTS LIST

## 3-1. F-2612 Power Supply Circuit Board (Stock No. 7501651)

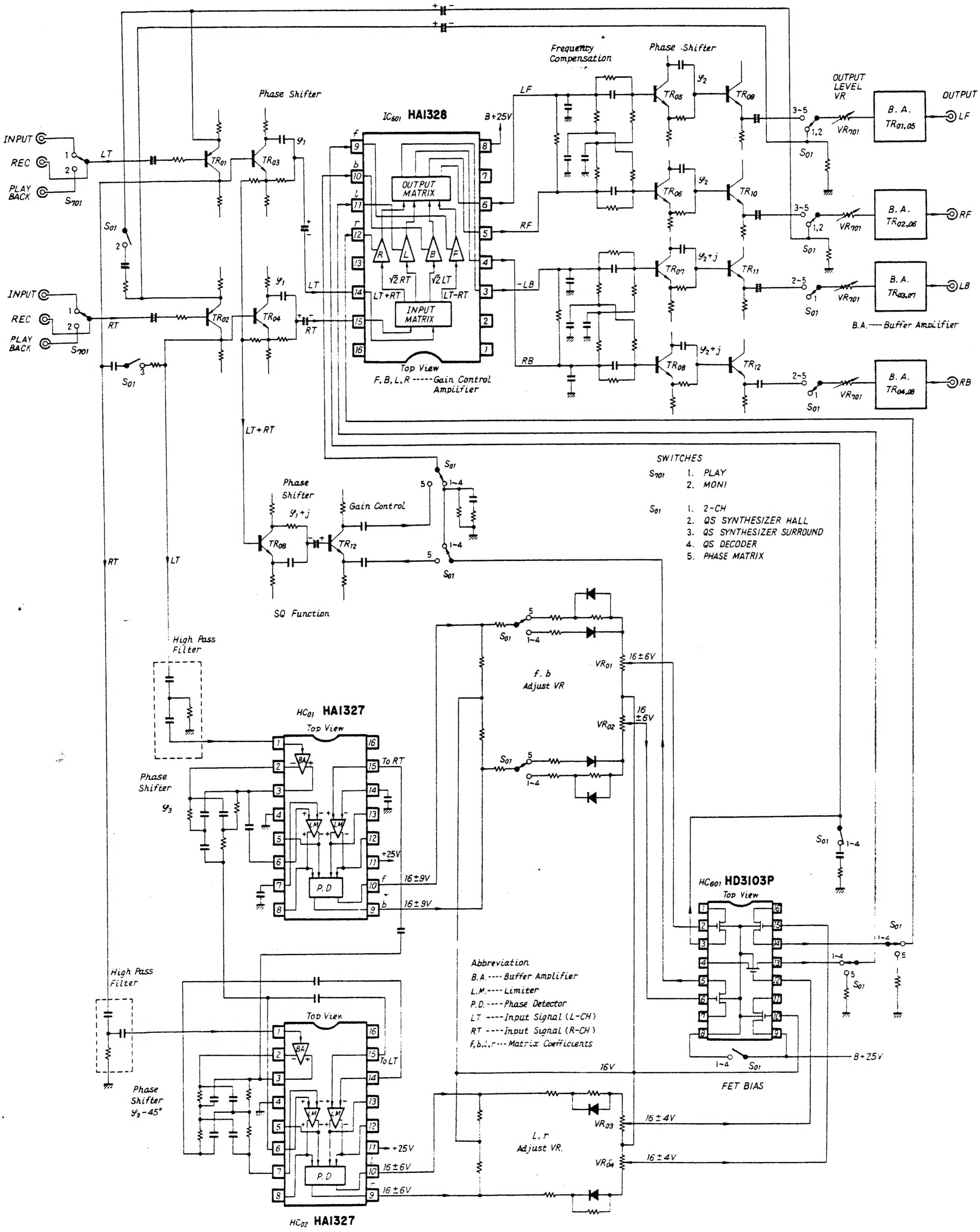
### Conductor Side




## Parts List

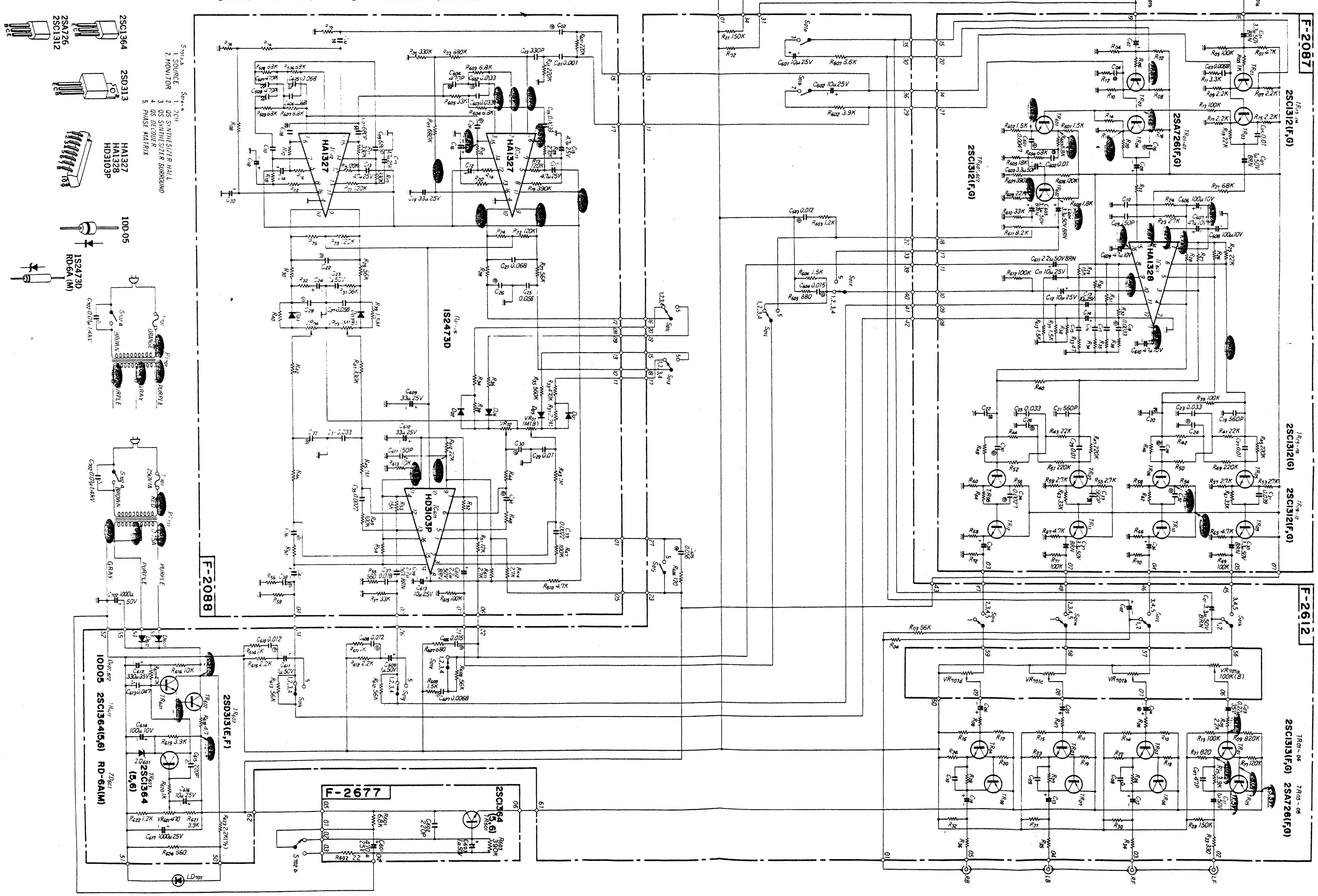
| Parts No. | Stock No. | Description | Position |
|---|---|---|---|
| TR01~04 | 0306070, 1 | 2SC1313 (F, G) | 1, 2C |
| TR05~08 | 0300470, 1 | 2SA726Ⓦ (F, G) | 1, 2C |
| TR601 | 0306130, 1 | 2SC1364 (5, 6) Transistor | 2C |
| TR602 | 0308392, 3 | 2SD313 (E, F) | 2C |
| TR603 | 0306130, 1 | 2SC1364 (5, 6) | 2B |
| D601 | 0310880 | 10D-05 Diode | 2C |
| D602 | 0310880 | 10D-05 | 2C |
| ZD601 | 0315550 | RD-6A M Zener Diode | 2B |
| C01 | 0519102 | 3.3μF 50V E.C. | 1A |
| C02 | 0519102 | 3.3μF | 2A |
| C03~06 | 0573228 | 0.22μF 35WV T.C. | 1, 2C |
| C07~10 | 0657470 | 47 pF 50V C.C. | 1, 2C |
| C11~14 | 0515109 | 1μF 50V E.C. | 1, 2C |
| C601 | 0513100 | 10μF 25V E.C. | 2A |
| C602 | 0513100 | 10μF | 2A |
| C603 | 0600127 | 0.012μF | 1A |
| C604 | 0600157 | 0.015μF | 2A |
| C605 | 0600567 | 0.056μF 50V M.C. | 1B |
| C606 | 0600157 | 0.015μF | 1A |
| C607 | 0600686 | 0.0068μF | 1A |
| C608 | 0600127 | 0.012μF | 1A |
| C609 | 0515109 | 1μF 50V E.C. | 1A |
| C610 | 0600127 | 0.012μF 50V M.C. | 1A |
| C611 | 0515109 | 1μF 50V E.C. | 1A |
| C612 | 0514331 | 330μF 35V E.C. | 2B |
| C613 | 0657473 | 47000 pF 50V C.C. | 2B |
| C614 | 0511101 | 100μF 10V E.C. | 2B |
| C615 | 0657221 | 220 pF 50V C.C. | 1A |
| C616 | 0513100 | 10μF 25V E.C. | 2B |
| C617 | 0513102 | 1000μF | 2B |
| R01~02 | 0107154 | 150kΩ | 2A |
| R03 | 0107563 | 56kΩ | 1A |
| R04 | 0107563 | 56kΩ ¼W C.R. | 1A |
| R05~08 | 0107222 | 2.2kΩ | 1, 2C |
| R09~12 | 0107824 | 820kΩ | 1, 2C |
| R13~16 | 0106104 | 100kΩ | 1, 2C |
| R17~20 | 0107124 | 120kΩ | 1, 2C |
| R21~24 | 0106821 | 820Ω | 1, 2C |
| R25~28 | 0106392 | 3.9kΩ | 1, 2C |
| R29~32 | 0106154 | 150kΩ | , 2C |
| R33~36 | 0106331 | 330Ω | 1, 2C |
| R601 | 0107562 | 5.6kΩ | 2A |
| R602 | 0107392 | 3.9kΩ | 1A |
| R603 | 0107122 | 1.2kΩ | 1A |
| R604 | 0107152 | 1.5kΩ | 2A |
| R605 | 0107681 | 680Ω | 2A |
| R606 | 0107121 | 120Ω | 1B |
| R607 | 0107681 | 680Ω | 1A |
| R608 | 0107563 | 56kΩ | 1A |
| R609 | 0107152 | 1.5kΩ ¼W C.R. | 1A |
| R610 | 0107563 | 56kΩ | 1A |
| R611 | 0107102 | 1kΩ | 1A |
| R612 | 0107222 | 2.2kΩ | 1A |
| R613 | 0107563 | 56kΩ | 1, 2A |
| R614 | 0107102 | 1kΩ | 1A |
| R615 | 0107222 | 2.2kΩ | 2A |
| R616 | 0107103 | 10kΩ | 2C |
| R617 | 0107472 | 4.7kΩ | 2B |
| R618 | 0107479 | 4.7Ω | 2C |
| R619 | 0107392 | 3.9kΩ | 2B |
| R620 | 0107102 | 1kΩ | 2B |
| R621 | 0107392 | 3.9kΩ | 2B |
| R622 | 0107122 | 1.2kΩ | 2B |
| R623 | 0103222 | 2.2kΩ ½W C.R. | 2C |
| R624 | 0107561 | 560Ω ¼W C.R. | 2C |
| VR601 | 1035050 | 470Ω(B) Volume | 2B |
| S01 | 1105210 | Function Switch | 1, 2A |
| | 2410720 | 4P Pin Ass'y (Type A) | |
| | 2410740 | 8P Pin Ass'y (Type A) | |
| | 2410750 | 10P Pin Ass'y (Type A) | |

# 4. BLOCK DIAGRAM



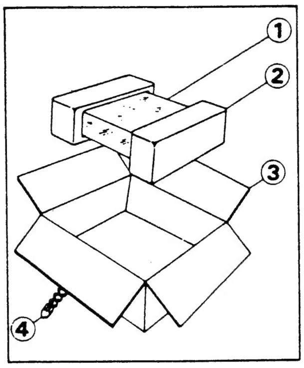
# 5. SCHEMATIC DIAGRAM

* La présention et les spécifications sont susceptibles d'être modifiées sans préavis par suites d'améliorations éventuelles.
* Änderungen, die dem technischen Fortschritt dienen, bleiben vorbehalten.
* Design and specifications subject to change without notice for improvement.



## 6. PACKING LIST

| Parts No. | Stock No. | Description |
|---|---|---|
| 1 | 9116042 | Vinyl Cover |
| 2 | 9027920 | Stylofoam Packing |
| 3 | 9009170 | Carton Case |
| 4 | 5996080 | Curl Stopper |




## 7. ACCESSORY PARTS LIST

| Stock No. | Description |
|---|---|
| 9209790 | Operating Instructions |
| 3810180 | Pinplug Cord |
| 9237370 | Schematic Diagram |

**※ Regarding Adjustment methods of QS vario-matrix on QSD-2, refer to Service Bulletin, Ref. AN-087.**